SAGE III

Sunsets and the Atmosphere

Lesson K-5

Title: Sunsets and the Atmosphere

Purpose: This lesson illustrates how sunsets and sunrises can give us information about the particles that can be found in the air we breathe. Through a variety of activities students will develop an understanding of the colors found in sunsets/sunrises and how those colors can provide information about our atmosphere. In 2015 NASA will be launching the Stratospheric Aerosol and Gas Experiment, or SAGE III instrument that is to be attached to the International Space Station (ISS). When attached to the ISS it will be taking ozone measurements during the sunsets and sunrises that it is able to see from its unique vantage point.

Grade Level: K-5

Estimated time for Completing Activity: 2 to 3 class periods

Learning Outcomes:

- The student will recognize that light travels in the form of waves that can be scattered, absorbed, and reflected.
- The student will use a prism to bend light into its various colors as seen in the visible spectrum.
- The student will learn that the color of a sunset is determined by the wavelength of light that is being scattered as it passes through the Earth's atmosphere.
- The student will recognize that the color of sunsets can provide information about the different types of particles found in the atmosphere.
- The student will develop an understanding of the importance of the measurements being taken by SAGE III on the International Space Station.

Standards

K-5 NGSS

1-PS4-3 Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.
4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

Virginia Standards:

5.3 The student will investigate and understand basic characteristics of visible light and how it behaves.

Vocabulary:

absorb	stratosphere	aerosols
scatter	particles	prism
reflect	pollution	wavelength
atmosphere	ozone	

Lesson Materials:

- Sunset Sky Color Data Recording Log
- Prisms
- Light Source
- Science Journal (Notebook)
- Colored Pencils
- Convex and Concave Lenses
- Laser Pointers
- Pen Light
- 4 Clear Round Glue Sticks (the ones that are used in glue guns)
- Clear tape
- White Paper
- Sunset Images

Lesson Links:

- The Air We Breathe Book K-4: (http://www.nasa.gov/pdf/62452main_The_Air_We_Breathe.pdf)
- What Color is Your Sky? http://mynasadata.larc.nasa.gov/what-color-is-your-sky/
- Why is the Sky Blue? http://spaceplace.nasa.gov/blue-sky/
- Sage III : http://sage.nasa.gov/

Background:

SAGE III on ISS is a key part of NASA's mission to provide crucial, long-term measurements that will help humans understand and care for Earth's atmosphere. The SAGE III instrument will measure the vertical distribution of aerosols and ozone from the upper troposphere through the stratosphere. The measurements taken by SAGE III will provide information about the amount of particles found in the atmosphere, which in turn affect the quality of the air we breathe. SAGE III will continue a long history of accurate measurements that provide the foundation for much of the environmental policy that is in place today. One of the first continuous Earth-observing instrument on the International Space Station, SAGE will

launch on SpaceX in 2015 and will be attached to the International Space Station via a robotic arm.

The light from the sun is made up of all of the colors of the rainbow: red, orange, yellow, green, blue, indigo, and violet (ROY G BIV). When viewed together the color that we see is white, but when viewed through a prism the colors are separated out into the different colors of the visible spectrum. The air in our atmosphere is made up of molecules of different gases that scatter the blue colors found in sunlight, which causes the sky to appear blue. Sometimes the air becomes polluted and this can result in colors other than blue being scattered across the sky. A clean, clear sky will appear blue while a hazy sky may take on a grayish or brownish tone; because of this scientists can learn a lot about the condition of the air by observing the color of the sky.

At sunset the light coming from the sun has to travel a longer distance, through a thicker layer of the atmosphere to reach our eyes, because of this the light is scattered in longer wavelengths and we are able to see the red and orange colors of light. If the atmosphere contains pollution, the reds and oranges can be enhanced as the various particles in the air cause an increase in the scattering of the light waves.

(**Teacher Note**: Use the lesson links provided to access additional background information.)

Pre-Lesson Activity:

Provide students with the ***Sunset Sky Color Data Recording Log*** and have them record the color of the sunset each night for two weeks prior to this lesson.

(**Teacher Note**: The younger students might not be able to accurately record the sky visibility and need to only be responsible for the color of the sky. A variation might be to have them color the box with a color close to what they see in the sky.)

Lesson Procedure:

Part 1:

Our World: Sunsets and Atmosphere (K-5)

NASA eClips: Our World Sunsets and Atmosphere
http://www.youtube.com/watch?v=fk6ulPBdivk&feature=youtube
YouTube: http://youtu.be/fk6ulPBdivk

After viewing the video discuss the Pre-Lesson Sunset Sky Color Data that was collected by the students.

- What were the different sunset colors that were observed?
- What might have caused there to be differences in the color they observed?
- What factors other than differences in color did they observe?

Part 2:

Glue Stick Activity

Materials:

- four glue sticks
- clear tape
- white paper
- penlight

1. Tape a sheet of white paper to the wall or white/chalk board in the classroom so that all of the students can see as you/or other students complete the demonstration.
2. Point one end of the glue stick toward the white paper on the wall, it should be approximately 1 centimeter away for best results.
3. Shine the penlight through the opposite end of the glue stick.
4. Observe the colors at each end of the glue stick.
5. Attach two glue sticks together end-to-end using the clear tape and repeat steps 2-4. Be sure to make note of the colors at each end of the glue sticks.
6. Follow these same steps with 3 and 4 glue sticks. Be sure to make note of the colors at each end of the glue sticks.

Teacher Notes:

The light near the penlight should be blue in color representing the color of the sky during sunrise hours, while the light near the opposite end of the glue stick will be orange or red in color representing the color of the sky near the time of sunset. This has to do with the distance the light is traveling and the wavelengths of light that are being scattered.

Part 3:
Have students practice using prisms to bend light into its various colors. Instruct the students to draw and color the layers of color that they see.

Part 4:
Demonstrate how light can bend as it passes through different materials by placing a pencil in a jar of water and having students observe, sketching what they see in their journals. **(TEACHER NOTE: It is important when using a laser at the elementary level to use the activity as a demonstration due to the dangers of allowing younger students to use a laser pointer that could result in eye damage)**

Add a couple drops of milk to the glass of water and shine a laser beam through the glass. What happens to the beam of light? Add a few more drops of milk and see what happens to the beam of light?

Part 5:
Provide students with a variety of lenses (convex, concave, etc). Have them observe and sketch the path of a laser as it travels through the lenses. (Make sure to closely supervise younger students using laser pointers in this part of the lesson.)

Part 6:
Provide students with a set of various sunset images. Working with a partner, have them predict what types of particles might be in the atmosphere based on the color and visibility of the sky. Discuss these as a class. (Make sure to discuss the importance of the SAGE III Instrument taking repeated measurements over an extended period of time via the International Space Station rather than from the surface of the Earth.)

Lesson Questions:

1. Why is the sky blue?
2. Why do sunsets sometimes differ in color?
3. How can the different colors of a sunset give us information about the particles found in the air we breathe?
4. Why does sunrise and sunset result in different sky colors?
5. What is the purpose of the SAGE III Instrument?
6. Why is it important to make repeated measurements rather than just one or two measurements at a time?
7. How is the accuracy of the data collected affected by collecting repeated measurements over an extended period of time?
8. By positioning the SAGE III Instrument on the International Space Station, what will it be able to do that is not possible from the surface of Earth?

Lesson Extensions:

1. **Sky Color for Kids Science Project:** http://mynasadata.larc.nasa.gov/804-2/sky-color-for-kids/
2. **Cell phone microscope:** http://www.amazon.com/Phone-Mobile-Microscope-Micro-iPhone/dp/B00A6MTIS2/ref=sr_1_2?ie=UTF8&qid=1373466141&sr=8-2&keywords=cell+phone+microscope
3. **Cell phone telescope:** http://www.amazon.com/Neewer%C2%AE-Optical-Telescope-Camera-Tripod/dp/B009YR2986/ref=sr_1_5?s=wireless&ie=UTF8&qid=1373466292&sr=1-5&keywords=cell+phone+telescope
4. **Cell phone spectrophotometer kit:** http://www.kickstarter.com/projects/jywarren/public-lab-diy-spectrometry-kit
5. **Cell phone spectrophotometer paper template:** http://www.asdlib.org/onlineArticles/elabware/Scheeline_Kelly_Spectrophotometer/PaperBaseplateTemplate3%20Layout1%20(1).pdf
6. **Cell phone spectrophotometer general instructions:** http://www.asdlib.org/onlineArticles/elabware/Scheeline_Kelly_Spectrophotometer/

7. **Cell phone spectrophotometer diffraction grating source and general instructions on how specs work: http://butane.chem.uiuc.edu/pshapley/Enlist/Labs/SpectrometerLab/Spectrometer.html**

Sunset Sky Color Chart:

Sunset Sky Color Data Recording Log

Sunday	***Monday***	***Tuesday***	***Wednesday***	***Thursday***	***Friday***	***Saturday***
Sky Color(s): ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***	***Sky Color(s):*** ***Sky Visibility:***
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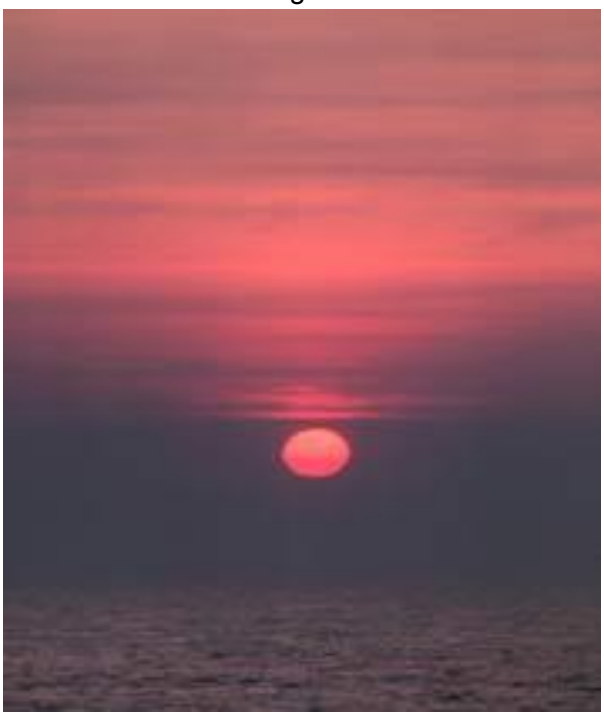
Sky Color(s): Describe the colors you see in the sky as the sun is setting.
Sky Visibility: Describe the visibility of the sky by using the following terms: unusually clear, clear, somewhat hazy, very hazy, or extremely hazy.

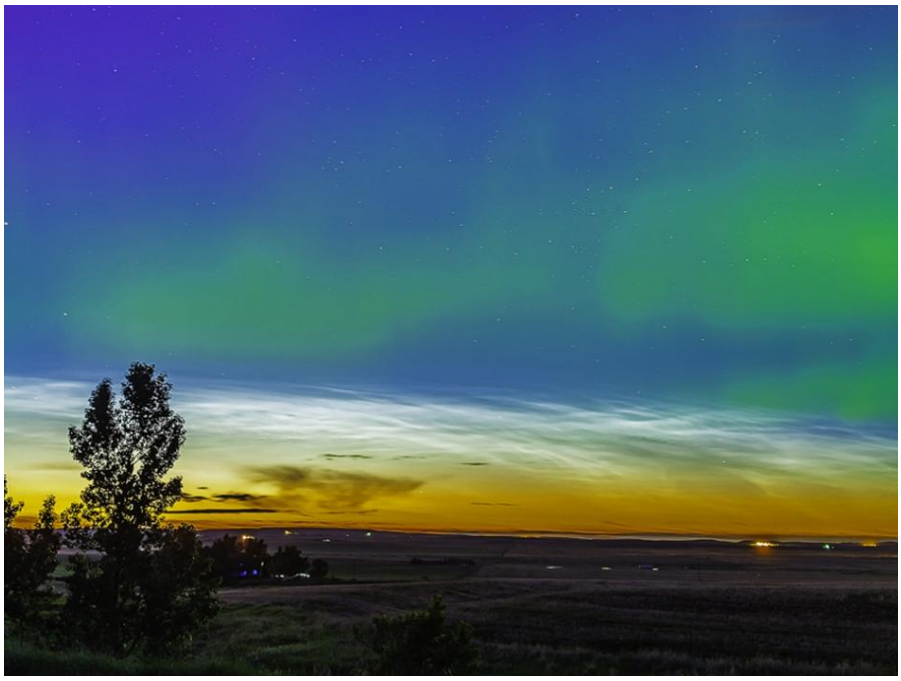
Sunset Images

Image #1



http://spaceplace.nasa.gov/blue-sky/

Image #2

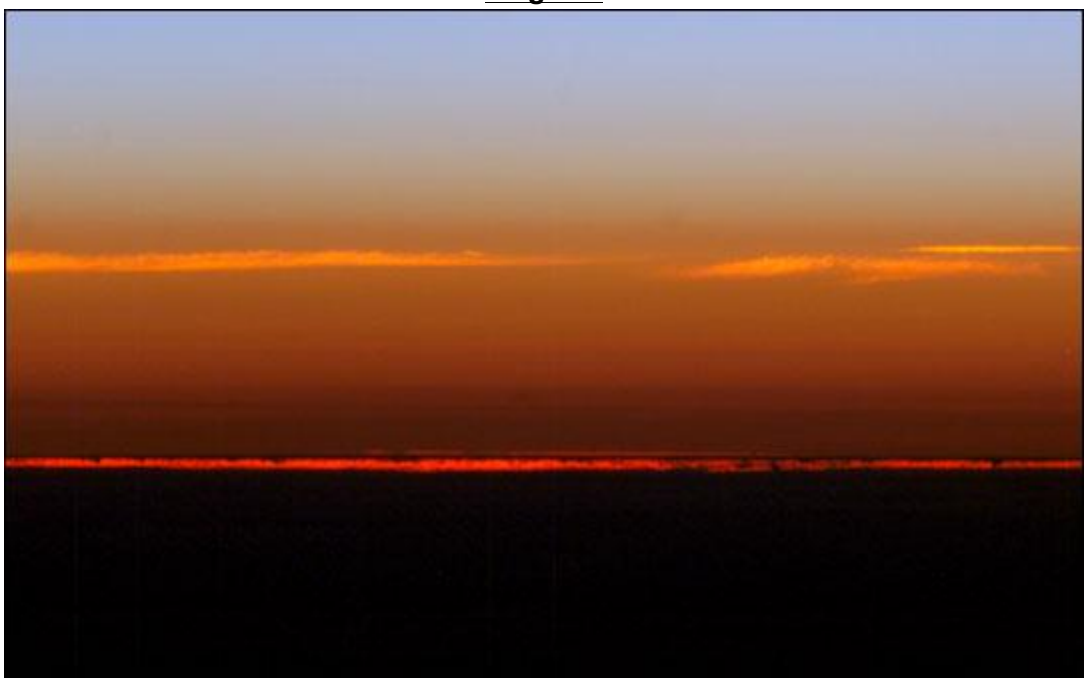


http://www.nasa.gov/content/goddard/sky-colors-trifecta/#.UjmnkGRT1fY

Image #3

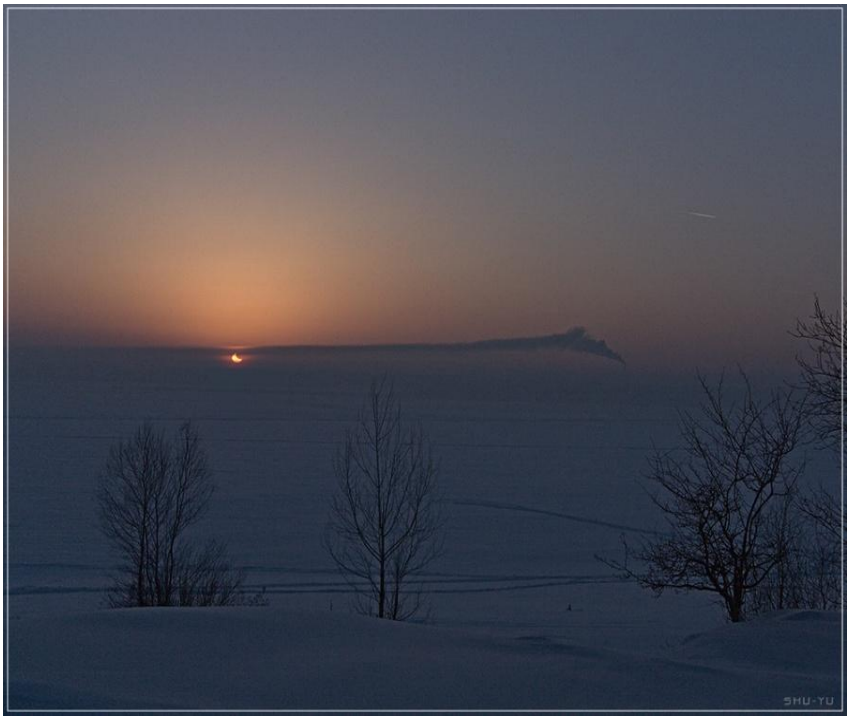
http://apod.nasa.gov/apod/ap100729.html

mage #4



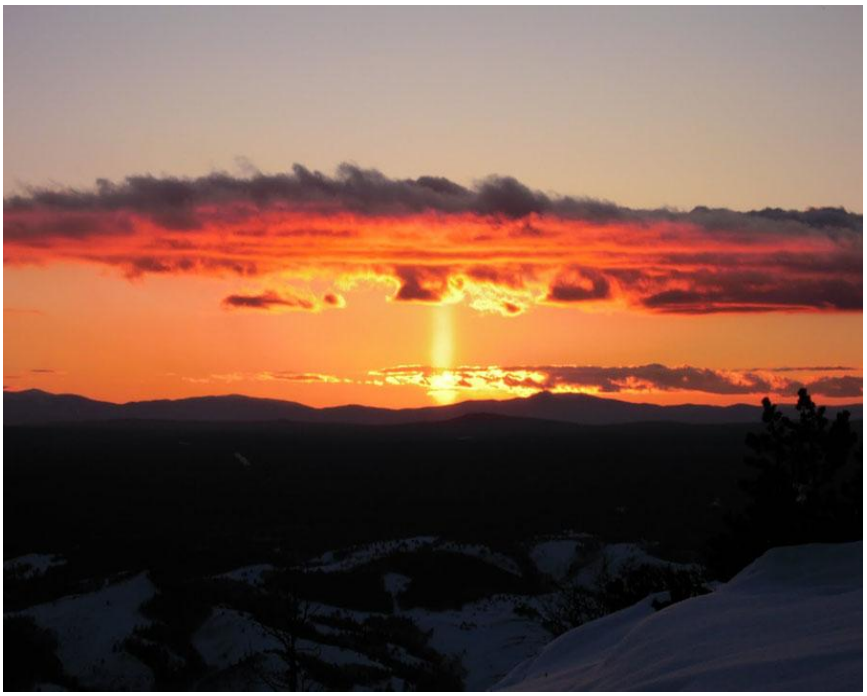
http://www.earthobservatory.nasa.gov/Features/EdLu/Images/ISS007-E-11204.jpg

Image #5



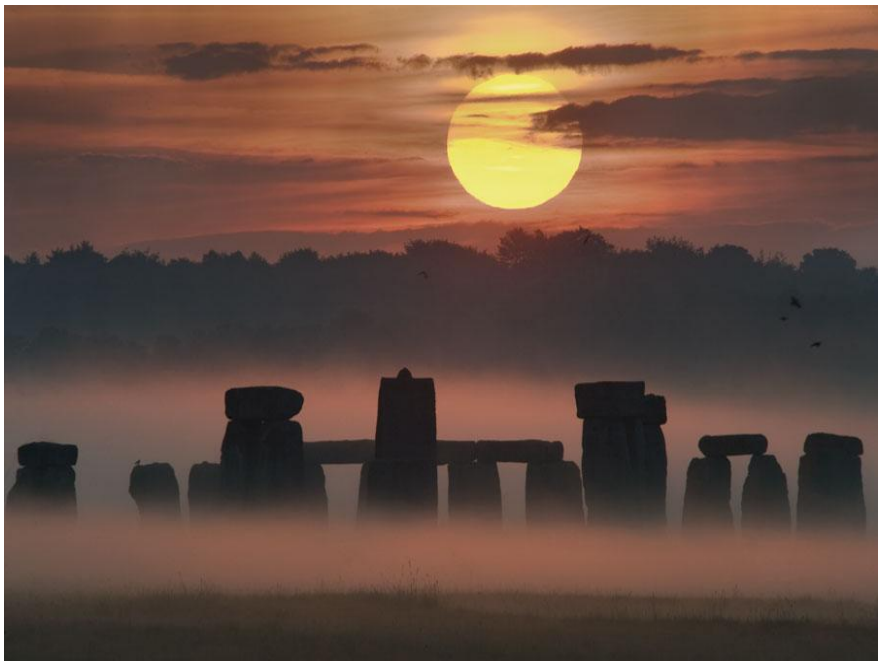
http://apod.nasa.gov/apod/ap110107.html

Image #6



http://apod.nasa.gov/apod/ap100306.html

Image #7



http://apod.nasa.gov/apod/ap100621.html